COPPER 8-QUINOLINOLATE

FUNGICIDE

EPA REG. NO. 10829-8

ACTIVE INGREDIENT:
COPPER 8-QUINOLINOLATE 95.0%
INERT INGREDIENTS: 5.0%
TOTAL 100.0%

EPA EST. NO. 39780-JP-01

WARNING! KEEP OUT OF REACH OF CHILDREN

THE FUNGICIDE IS SOLD TO FORMULATORS FOR MANUFACTURING PURPOSES AND TO APPLICATORS WHO MAY WISH TO PREPARE THEIR OWN DISPERSION OR SOLUBILIZED SYSTEM

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS & DOMESTIC ANIMALS
CAUTION

Harmful if swallowed. Avoid contamination of food and contact with skin, eyes. If swallowed, drink large volume of water and induce vomiting. If in contact with eyes or skin, flush with water.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Do not apply directly to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling

STORAGE AND DISPOSAL
PROHIBITIONS

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.

NET WT.: 88 lbs. (40 kg.) LOT NO. .....

PESTICIDE DISPOSAL

Pesticide, spray mixture or rinstate that can not be used according to label instructions must be disposed of according to Federal, State or local procedures under the Resource Conservation and Recovery Act.

CONTAINER DISPOSAL

Dispose of liners according to approved Federal, State or local procedures under the Resource Conservation and Recovery Act. Dispose of in a sanitary landfill or by incineration if permitted by State and local authorities.

GENERAL

Consult Federal, State, or Local authorities for approved alternative procedures such as limited open burning.

SEE TECHNICAL BULLETIN FOR COMPOSITION, TOXICITY, METHODS OF USE, RESTRICTIONS, AND EFFECTIVENESS.

TANABE U.S.A., INC.
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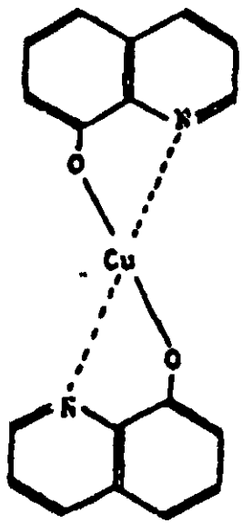
SAN DIEGO, CALIF. 92111
(619) 571-8110

TECHNICAL BULLETIN

OF

Copper 8-Quinolinolate



Telex #910-335-1567 • FAX. (619) 571-2478

COPPER 8-QUINOLINOLATE

Copper 8-Quinolinolate is a copper chelate compound of 8-quinolinol and is practically non-ionizable. Its copper is bonded firmly by both primary and secondary valence linkages, making the compound very stable.

Copper 8-Quinolinolate as offered by TANABE, U.S.A., INC. is a highly stable, highly effective, low toxicity industrial fungicide. The fungicide is sold to formulators for manufacturing purposes and to applicators who may wish to prepare their own dispersion or solubilized system.

Theoretical figures:

Formula: $Cu(C_9H_6ON)_2$

Molecular Wt.: 351.85

Contents:

Copper 8-Quinolinolate	95.0%
(8-quinolinol anion	77.84%)
(Copper cation	17.16%)
Inert ingredients	5.0%

Specifications:

1. Melting point - 210° C with decomposition
2. Boiling point - None
3. Vapor pressure - None
4. Density
   Specific gravity - 1.68
5. Hydrolysis rate
   Solubility in water - 0.8 ppm (at 25°C)
   No hydrolysis in water
6. Dissociation constant - 1 gm. K = 25.8
7. Physical State - crystalline powder
8. Color - Yellowish green
9. Odor - Odorless
10. Stability
    It is stable at relatively high temperatures (205°C), and is not affected by ultraviolet or other actinic rays.
11. Commercial Components

Copper 8-quinolinolate	- 95.0% to 96.0%
Sodium sulfate	- 3.2% to 4.8%
Water	- 0.8% to 1.2%

* Manufactured by Tomono Nohyaku Co. Ltd. - Japan

Analytical Procedures:

1. Electrolysis - For copper determination

   Apparatus and reagents

   - Electrolysis apparatus
   - 2 N Sulfuric acid
   - Succinic acid (analytical grade)
   - Acetone

   Method

   Put into the electrolysis pot or retort an accurately weighed amount of about 1.4 gms of the sample and 20 ml of 2 N sulfuric acid.

   When dissociation is complete, introduce 200 ml of water and 1 gm of succinic acid.

   Electrolyze during 1 hour while mixing, with a 2A electrical current.

   When electrolytic process is ended, pull the cathode out, wash it with distilled water and acetone and dry it in a drying box for five minutes at 105°C.

   After cooling in a desiccator, weigh the settled copper.

   $$\text{Copper \%} = \frac{M \times 100}{P}$$

   $$\text{Copper 8-quinolinolate \%} = \frac{M \times 100 \times 351.6}{P \times 63.6}$$

   P is the weight in grams of the sample.
   M is the weight in grams of the settled copper.

2. Characterization of the Copper 8-Quinolinolate molecule

   Trace the UV spectrum of a very dilute solution of Copper 8-quinolinolate in methylene chloride.
   Work between 200 and 450 nanometers.
   Maximum of absorption can be observed at the following:

   410 nm, 335nm, 320 nm, 265 nm, and 220 nm

3. Water Content

   Dry in a drying box at 120°C for 4 hours using an accurately weighed amount of about 2 gms.
   Water loss can be determined as the loss in weight of the sample.

4. Sodium sulfate

Wash the sample with distilled water at least three times, and use the washings as a test solution. Titrate sodium sulfate in the solution with barium chloride ($BaCl_2$) and then determine the content of sodium sulfate.

Toxicity:

Copper 8-Quinolinolate is of a low order of toxicity and therefore may be used in many areas where intimate skin contact or other types of human or animal exposure is possible. It is toxic to fish[2] and should not be used in areas where drainage into streams, lakes, ponds, or other forms of running water is possible.

Its acute oral toxicity (LD_{50}) is greater than 3000 mg/kg[2] when tested on rats, whereas its dermal toxicity is greater than 2000 mg/kg when tested on rabbits and is not irritating to the skin. It is considered slightly irritating to the eyes.

Tests on birds indicated no harmful effects when levels up to 10,000 ppm were consumed, at which point the tests were discontinued.

LD_{50} (mouse/ip.) : 67 mg/kg[3]

Uses:

Copper 8-Quinolinolate is recommended for use in the preservation of textiles, ropes, twine, conveyor belts, fire hose, paper, wood, plastics, paints and coatings, and adhesives.

It is required to meet the requirements of numerous U.S. and Canadian military specifications, and is allowed for use in sanitation procedures in meat and poultry establishments by the U.S. Department of Agriculture where direct food contact is not likely. It is accepted by the U.S. Food and Drug Administration for use in paper which will come into contact with drug and fatty foods and in food harvesting containers for raw agricultural products.

Copper 8-Quinolinolate may be applied in the form of a solubilized system in solvent or aqueous applications or it may be applied by dispersing (with the assistance of suitable dispersing agents) in a satisfactory, fine particle formulation in solvent or aqueous systems.

In the treatment of wood, it has been accepted for use as a dip or spray application or for pressure treatment and for controlling wood rotting organisms, surface growers and various boring insects.

It may be applied by standard treating techniques in or on many other substrates.

Copper 8-quinolinolate is recommended for formulatio into paints, protective coatings and adhesives to produce products which are highly resistant to fungal growth.

Adhesives: It is recommended that levels of from 0.015 to 0.1% by weight of Copper 8-quinolinolate be used for the protection of adhesives and glues, based on the weight of the finished product, to protect the product while in the can.

Paints: Copper 8-quinolinolate should be used at levels of from 0.1% to 1.0% based on the volume of the finished product. The median level of 0.5 to 0.75% is most generally used and has remained free from mold after two years under conditions where ordinary paint becomes contaminated after 60 days of exposure.

Copper 8-quinolinolate will impart a greenish-yellow color to white paints. This color is easily obscured by the use of proper pigmentation. Off-whites are produced by the use of sufficient Titanium dioxide. Reactive pigments should be avoided.

Use Precautions: Do not use in paints and pigments that may come into contact with food and feed.

Mildew Inhibitor for Paper, Paperboard and Textiles: Copper 8-quinolinolate will impart mildew resistance to papers such as asphalt laminates, wax papers, and packing papers.

The addition of from 0.25 to 0.5% by weight of Cu8 to paper should provide sufficient fungal protection to paper products. Copper 8-quinolinolate is added to the wet presses on paper machines, size press, and as part of a coating either on or off the machine or at the calendars consistent with normal mill practices.

Textiles: It is recommended that from 0.25% to 1.5 % Copper 8-quinolinolate (0.045% to 0.27% by weight of copper as metal) be incorporated into textiles for commercial and or Federal Specifications requirements. Water repellent components may be incorporated with the Copper 8-quinolinolate if desired.

Treatment of Wood-Dip Treatment: Treatment of wood including the following representative wooden items: Wooden flooring and decking for trucks, trailers, railroad cars, and patios. Beverage cases, wood rail beams, ladders, wooden shingles, mine timbers, interior holds of boats and millwork, greenhouse benches and flats used for growing ornamentals and mushroom trays are all areas where Copper 8-quinolinolate has been successfully used to prevent mildewing.

Preparation of treating solution: A 0.1% to 1.0% by weight solution of Copper 8-quinolinolate in water or mineral spirits may be prepared using wetting or dispersing agents. Lumber and wooden containers should be totally submerged in this treating solution for a period of from 3 seconds to 3 minutes depending upon the absorption required. Beverage containers are usually dipped for a period of 5 seconds while lumber is dipped for 3 minutes. The treated wood should then be drained of excess solution and allowed to air dry. Protection against mildew and rotting may be as long as two years.

Brushing or spraying: The above wood items may be treated by the same treating solution by brushing or spraying providing that the process continues to run-off. It may be necessary to apply a second coat if absorption is slow or poor.

Pressure Treatment of Wood: Copper 8-quinolinolate has been used in the pressure treating process to prevent rotting. In this case a solubilized type of formulation is preferred although an extremely fine dispersion is also acceptable. Cured wood is placed in a pressure treating cylinder and a 0.05% formulation is used to flood the cylinder. Because settling out is undesirable, a solubilized or fine dispersion will minimize settling. Pressure is applied as usual and held for various time periods depending on the size of the lumber being treated. A minimum retention level of 0.01 lbs. per cubic foot is desirable.

Treatment of Rope: Copper 8-quinolinolate is applied to rope during the carding process. A formulation should contain from 0.25 to 1.0% of Copper 8-quinolinolate. When the rope forming process is complete, a rope will have a very even light yellow-green color and be protected from rotting for several years.

Twine: Twine is treated by passing the finished twine through a formulation containing 0.25 to 1.0% Copper 8-quinolinolate. If a sizing is to be used, this could be added to the treating solution.

Conveyor Belts: Because conveyor belts always contain either a rubber or size finish, Copper 8-quinolinolate may be added to this finish at a level of from 0.25 to 0.5%. If the conveyor belt is to be made of several layers, each layer should be treated before the finished conveyor belt is prepared.

Fire-hose: The fire-hose is to be treated before a rubber lining is introduced. See section on Textile Treatment for amounts to be used. If natural rubber is to be used as the lining, Copper 8-quinolinolate should not be used on the jacket.

Plastics: Copper 8-quinolinolate may be used in poly-vinyl-chloride by adding it to the plasticizer. A level of 0.5% is recommended. It also may be added to poly urethane formualtions before final processing.

Note: Any plastic that does not contain plasticizers is probably only minimally susceptible and may not need a fungicide to control mildewing.

Antimicrobial Activity:

1. Antifungal activity[1,4]

Fungi	Copper 8-quinolinolate, ppm	
	Fungistatic concentration	Fungicidal concentration
Aspergillus niger	2	50
Aspergillus oryzae	4	50
Trichoderma viraide	2	50
Myrothocium verrucaria	3	3
Trichophyton mentagraphytes	2	2

In Sabouraud's liquid culture medium at 28°C after 6 days in shake flasks.

Fungi	Type	Copper 8-quinolinolate, %	
		Inhibiting concentration	Killing concentration
Penicillium sp.	General mold	0.001	
Aspergillus niger	General mold	0.05	
Aspergillus ustus	General mold	0.05	0.05
Chaetomium globosum	Textile rotter	0.001	0.05
Myrothecium verrucaria	Textile rotter	0.20	
Metarrhizium sp.	Textile rotter	0.001	
Trichophyton interdigitale	Athletics foot fungus	0.001	

Determined by malt-agar-petri dish test.

2. Antibacterial activity[4)]

Bacteria	Copper 8-quinolinolate, ppm	
	Bacteriostatic concentration	Bactericidal concentration
Escherichia coli	100	
Staphylococcus aureus	4	4
Streptococcus faecalis	11	11
Pseudomonas aeruginosa	100	
Leuconostoc mesenteroides P-60	11	15

At 37°C after 3 days in trypticase soy broth.

Notice to Formulators:

Although Copper 8-Quinolinolate as offered by TANABE U.S.A., INC. is considered a highly effective, long lasting and low toxicity material, it is important to keep the following factors in mind when developing formulated products:

1. All formulations to be sold to other companies or organizations must be registered individually with the Environmental Protection Agency before they may be sold.

2. Labels which are developed for formulations must conform to labels currently accepted by EPA and to the uses specified herein.

References:

1. Benignus, F.G., Industrial and Engineering Chemistry, 40, 1476 (1948)
2. TOMONO NOHYAKU BINRAN (Tomono Pesticide Handbook), 1977
3. Registry of Toxic Effects of Chemical Substances NIOSH (1978)
4. Gershon, H. and Parmegiani, R.: Applied Microbiology, 11, 62, (1963)

(November, 1989)